Space Weather Technical Forecast

Issued on Saturday, 18 November 2023 at 01:16 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Increasing risk of M-class flares throughout the period.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has remained Low over the past 24 hours, with the background level x-ray flux gradually increasing to C-class levels. The largest flare was a C1.7 at 17/1502 UTC, most likely from the new region rotating onto the southeast limb, which is currently classified as Cso/beta. The only other region on the visible disc is AR3486 which is currently classified as Dao/beta and is in the western hemisphere. Both regions are stable but also hard to analyse, due to their proximity to the eastern and western limbs respectively.
There have been a few CMEs in the last 24 hours but none are expected to be Earth directed.
Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE and DSCOVR at L1, started at Slightly Elevated levels around 400 km/s but eased down to ambient and is currently around 350km/s. It is possible that a very weak connection to CH70/- did occur early in the day, as the Phi angle was negative (towards the Sun) between approximately 17/0300-0600. However, the rest of the time the Phi angle was mainly positive (away from the Sun), and so any connection to CH70 was weak and temporary. The solar wind density trend was unremarkable - complicated by the switch in measuring satellites but staying below average to average throughout. The IMF was weak, at or below 4nT, while the north-south component ranged between -3 and +3nT. The resulting geomagnetic activity was Quiet (Kp 0-1).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux remained at Background levels. GOES16 high energy (greater than 2MeV) electron flux was predominately moderate throughout the period, with a peak of 340 pfu at 17/1440 UTC. The associated 24-hour fluence showed an gradually increasing trend, but despite this remained below the Active threshold (1e8 integrated pfu) threshold. The fluence observation at 18/0001UTC was 1.08e7 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to remain Low, but with an increasing chance of isolated M-class flares due to the new region that is currently rotating onto the southeast limb, plus other regions that are expected to rotate onto the visible disc through the forecast period.

Solar Wind / Geomagnetic Activity: The CME associated with the 16/0100 UTC filament eruption may reach Earth late tomorrow (19th) or early day 3 (20th), but confidence is low regarding this. Any arrival is unlikely to produce a significant geomagnetic response.
The solar wind is expected to remain at predominantly background levels for much of today. Slightly elevated wind speeds may occur from late today due to coronal hole influence, from a narrow coronal hole feature in the western hemisphere. The influence of this thin coronal hole is likely to wane later in the period.

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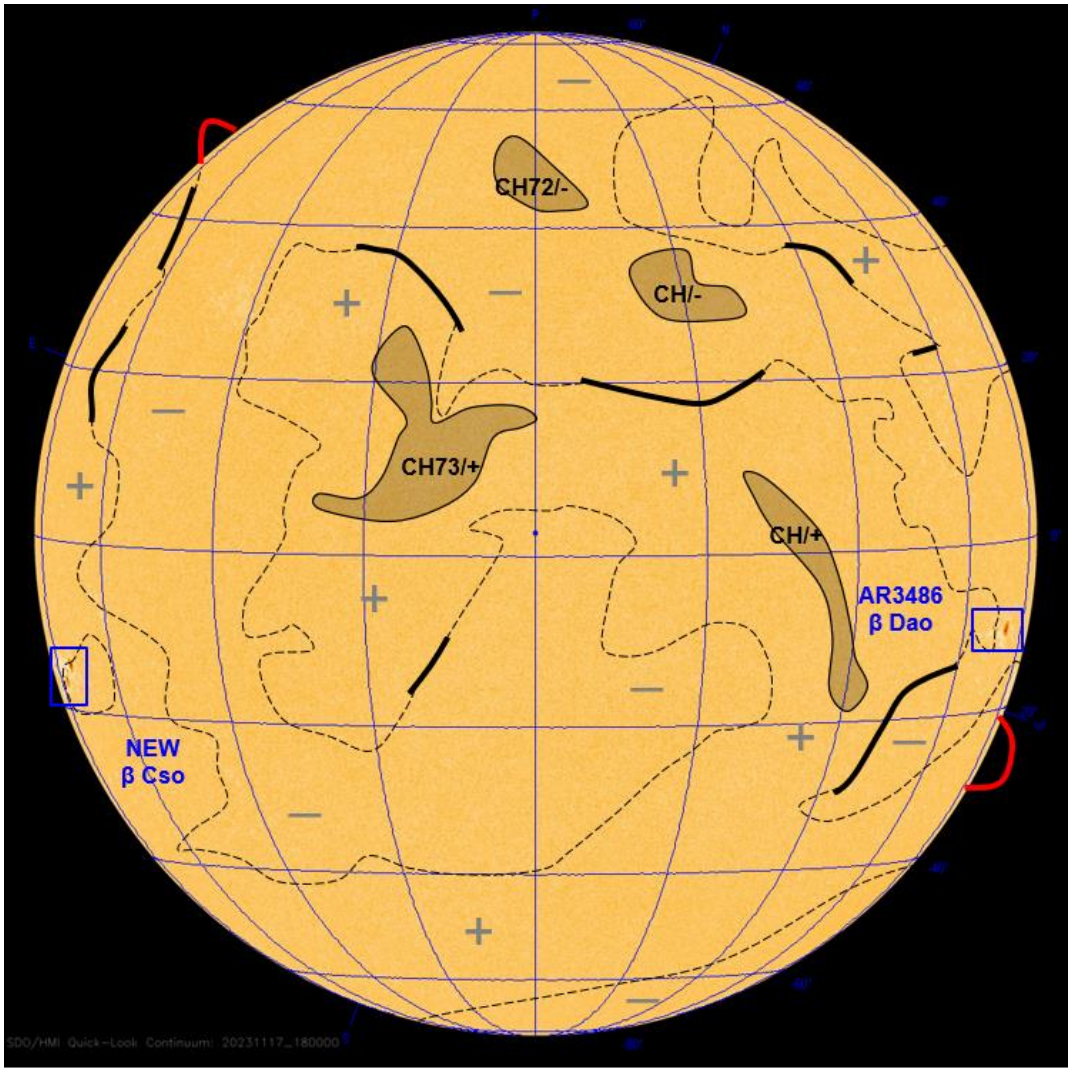
Geomagnetic activity is expected to be Quiet at first (Kp 0-2) then from late today until late tomorrow or early day 3 (20th) occasional Unsettled (Kp 3) intervals are possible. Then from late tomorrow or early day 3 (20th) there is a chance of G1/Minor geomagnetic storm (Kp 5) intervals, decreasing to a slight chance on day 4 (21st) due to the possible arrival of the above mentioned CME. However, there is significant uncertainty regarding the arrival time and impact of the CME.

Energetic Particles / Solar Radiation: GOES16 High energy proton flux is expected to remain at Background. GOES16 High energy electron flux is expected to continue at moderate levels today, perhaps increasing temporarily to High levels tomorrow (19th) due to the arrival of a weak high speed stream. The potential CME arrival on day 3 (20th) and associated geomagnetic activity is likely to return flux levels down to background during day 3 (20th), but day 4 (21st) flux levels may reach High at the peak of the diurnal cycle. The associated 24-hour electron fluence is expected to remain below the Active (1e8 integrated pfu) level, but perhaps with a gradually increasing trend today and tomorrow.

Figure 1. Solar Analysis Valid 17/1800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

The CME associated with the 16/0100UTC filament eruption may reach Earth late tomorrow (19th) or early day 3 (20th), but confidence is low regarding this.There is a range of arrival times as shown by Enlil ensembles. Impacts however are most likely to be limited.
The solar wind is expected to remain at predominantly background levels for much of today. Slightly elevated wind speeds may occur from late today due to coronal hole influence, from a narrow but yet to be numbered coronal hole feature in the western hemisphere. The influence of this thin coronal hole is likely to wane later in the period.

Geomagnetic activity is expected to be Quiet at first (Kp 0-2) then from late today until late tomorrow or early day 3 (20th) occasional Unsettled (Kp 3) intervals are possible. Then from late tomorrow or early day 3 (20th) there is a chance of G1/Minor geomagnetic storm (Kp 5) intervals, decreasing to a slight chance on day 4 (21st) due to the possible arrival of the above mentioned CME. More likely from late tomorrow Unsettled to Active conditions will occur. However, there is significant uncertainty regarding the arrival time and impact of the CME.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	5	20	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
16/1100	Partial	Filament eruption	NW	400 km/s	19/2000 UTC	Low confidence for arrival time

Figure 2: Met Office Enlil ensembles

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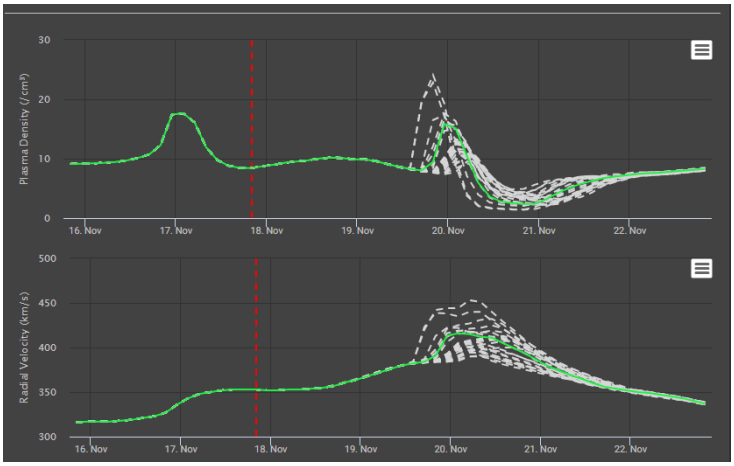

Radio Blackouts - X-Ray Flares:

There are currently only two sunspot regions on the visible disc. Of these AR3486 remains classified as Dao/beta, but is becoming more difficult to assess as it approaches the west limb. An as yet unnumbered region is visible on the southeast limb but is still difficult to analyse at this stage. It currently appears that the leading three spots are all the same polarity, with two further trailing spots starting to become visible. Both regions appear stable.

Low activity has been observed over the last 24 hours, with the background flux level now at C-class. The largest flare was a C1.7 peaking at 17/1502 UTC from the new sunspot region rotating onto the southeast limb. This new region increases the probability of flaring, with a chance of M-flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	20	20	25	25
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy (greater then 10Mev) proton flux observed by GOES16 is currently at Background levels and expected to persist at this level. The main risk of any increase to the proton flux will be from any notable filament eruptions, however these are currently considered

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unlikely to reach the S1 level.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

GOES16 High energy electron flux is expected to continue at moderate levels today, perhaps increasing temporarily to High levels tomorrow (19th) due to the arrival of a weak high speed stream from the narrow coronal hole feature in the western hemisphere. The potential CME arrival on day 3 (20th) and associated geomagnetic activity is likely to return flux levels down to background during day 3 (20th), but day 4 (21st) flux levels may reach High at the peak of the diurnal cycle.

The associated 24-hour electron flux is expected to remain below the Active (1e8 integrated pfu) level, but with an increasing trend, which is not shown by the Met Office REFM model. However, the REFM model does show the fluence remaining below the Active threshold, which is accepted.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	10	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: Met Office REFM model.

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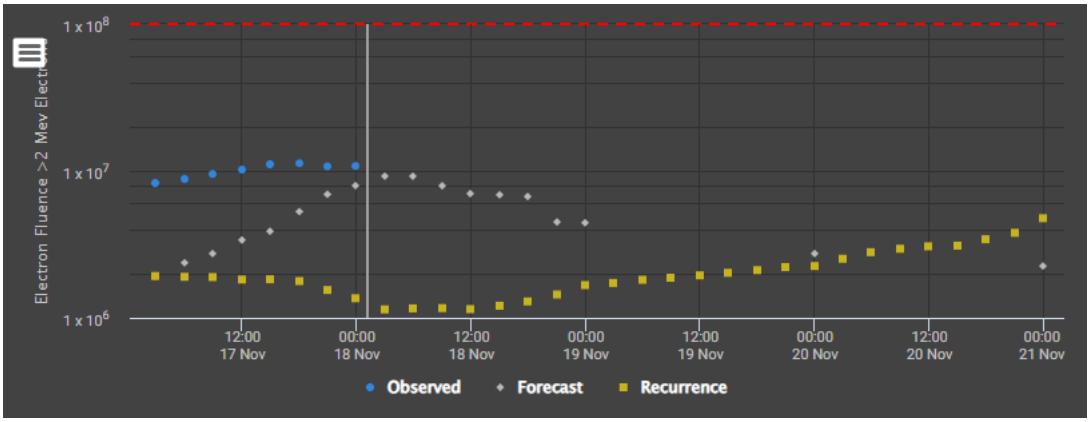

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